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AIR QUALITY ASSESSMENT
THUNDER BAY TERMINALS
LIMITED, THUNDER BAY, 1989.

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AIR QUALITY ASSESSMENT
THUNDER BAY TERMINALS LIMITED
THUNDER BAY
1989

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TECHNICAL ASSESSMENT SECTION
NORTHWESTERN REGION
ONTARIO MINISTRY OF THE ENVIRONMENT
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INTRODUCTION

Since 1978, Thunder Bay Terminals Limited has operated a bulk storage and transshipment facility adjacent to Thunder Bay harbour. Air assessment studies (including air quality monitoring, vegetation, soil and snow sampling) have shown that there has been no increase in dust levels off company property as a result of operations at the terminal. In 1989, the terminal processed nearly 4 million tonnes of bituminous coal and lignite, about 1.4 million tonnes of potash, and small amounts of agricultural products and wood chips.

AIR QUALITY DATA FOR 1989

DUSTFALL

In 1989, monthly dustfall was measured at the six sites shown in Figure 1. Thunder Bay Terminals provided data for sites 1, 3, 6 and 7. Sites 9 and 10 are part of the Ministry's monitoring network.

The 1989 dustfall results (Table 1) show that at locations off company property (sites 1, 9, and 10), monthly dustfall never exceeded Ontario's maximum acceptable limit of $7 \text{ g/m}^2/30 \text{ d}$ (grams of total dustfall per square metre during 30 days). The annual dustfall objective ($4.6 \text{ g/m}^2/30 \text{ d}$) was also easily met at all three off-property sites. At the three monitoring locations on Thunder Bay Terminals property, dustfall levels were occasionally above the monthly objective. Dustfall at two of the three on-property sites met the annual objective, while one was slightly above.

Average dustfall at the six monitoring sites in 1989 was similar to averages for recent years (Table 2). Dustfall levels have shown no trend over the past 10 years.

TOTAL SUSPENDED PARTICULATE MATTER (TSP)

Suspended particulate matter (TSP) comprises particles of small size which remain entrained in the air for long periods. TSP at three locations was measured for a 24-hour period every sixth day during 1989, using a standard high-volume sampler. Table 3 shows that during the year, TSP met the annual objective ($60 \mu\text{g}/\text{m}^3$) at all monitoring sites. There were no exceedences of the daily objective ($120 \mu\text{g}/\text{m}^3$) either on or off company property. Average TSP at the three sites (Table 4) was similar to values recorded for many of the 13 preceding years; TSP levels showed no trend from 1976 to 1989.

SNOW SAMPLING SURVEY

Methods

In response to complaints of black particulate matter appearing on the snow surface southeast of McKellar Island, a snow sampling survey was conducted in February, 1990.

At the sites shown in Figure 2, plus two control locations remote from the study area, single samples of snow were collected with a clear acrylic cylinder, 15 cm inside diameter. Core samples of the complete snow profile were obtained by inserting the cylinder to ground level. Snow was then manually cleared from one side of the cylinder. The cylinder was lifted 5 to 10 cm off the ground and a clean plastic shovel inserted under its base. The shovel and

cylinder were raised together and the snow was dumped into a clean, heavy-gauge, polyethylene bag. The bagged sample was retained in a frozen state until the sample could be processed. The number of cores from each site was recorded, plus the total depth of snow, depth of fresh snow, and the kind and amount of visible contaminants. Just before melting, snow samples were transferred to clean, polyethylene bags in the laboratory. These bags were sealed with twist ties and placed in clean plastic pails. Melting then proceeded at normal indoor temperatures. After melting was complete, the contents of each bag were shaken to distribute particulate matter evenly in the meltwater. The contents of each bag were poured into a graduated 4-litre beaker and the volume recorded. Each sample was then poured into 5, 500-ml plastic bottles for submission for analysis. The aliquot for aluminum and iron analysis was preserved with nitric acid. Those for other parameters were left unpreserved. Determinations of aluminum, chloride, conductivity, iron, pH, potassium and residues were performed at the Ministry's Thunder Bay laboratory. Carbon was analysed at the Ministry's Toronto laboratory.

The results of the survey are interpreted in relation to contaminant guidelines developed by the Ministry for snow. Values above guidelines exceed the upper limit of normal for northwestern Ontario, but health or environmental effects do not necessarily occur. Contaminant guidelines have no legal status in Ministry legislation, but they serve as useful indicators of possible contaminant problems.

Results

Analysis results of the Thunder Bay Terminals survey are presented in Table 5. The data show that aluminum and iron were elevated above contaminant guidelines near the coal

piles, but off-property spread of these metals was not significant. Chloride and potassium levels exceeded guidelines at the north end of Thunder Bay Terminals property, but were normal off property. Total solids and particulate carbon (a tracer for coal particles) exceeded contaminant guidelines at all sampling sites, except controls. The distribution pattern for carbon (which was similar to the solids pattern) is shown in Figure 3. The fallout pattern of coal particles in Figure 3 is similar to the zone of visible fallout shown in Figure 2. Black particulate matter was seen on or below the snow surface at sampling sites 5-7, 13-15, and 18-28.

Concentrations of four parameters in snow are compared in Table 6 for years before the terminal was in operation (1975, 1976) and for years under normal operating conditions (1979, 1980, and 1990). The comparison reveals that pre-operational levels of aluminum, carbon, iron and suspended solids were much lower than operational levels at sampling sites on Thunder Bay Terminals property. Off-property levels showed little change. Concentrations at all sites were usually lower in 1990 than in 1979 and 1980.

In 1990 at sampling points on Lake Superior (sites 18-28, Figure 2), aluminum concentrations ranged from 300 to 1000 $\mu\text{g/l}$. Carbon was 30-200 mg/l , chloride 400-1600 $\mu\text{g/l}$, iron 500-1700 $\mu\text{g/l}$, and potassium 200-700 $\mu\text{g/l}$. At these levels, the impact on water quality of Lake Superior would probably not be significant, due to the large dilution when the snow and ice melted. However, the ongoing occurrence of such fallout is undesirable, and abatement action to minimize windblown coal particles during the winter should be considered.

CONCLUSIONS

Average dust levels, measured as dustfall and suspended particulate matter, continued to be recorded at satisfactory levels around Thunder Bay Terminals in 1989. A snow sampling survey in early 1990, however, showed that windblown coal particles were being deposited off property on Lake Superior. An abatement program to correct this fallout is suggested.

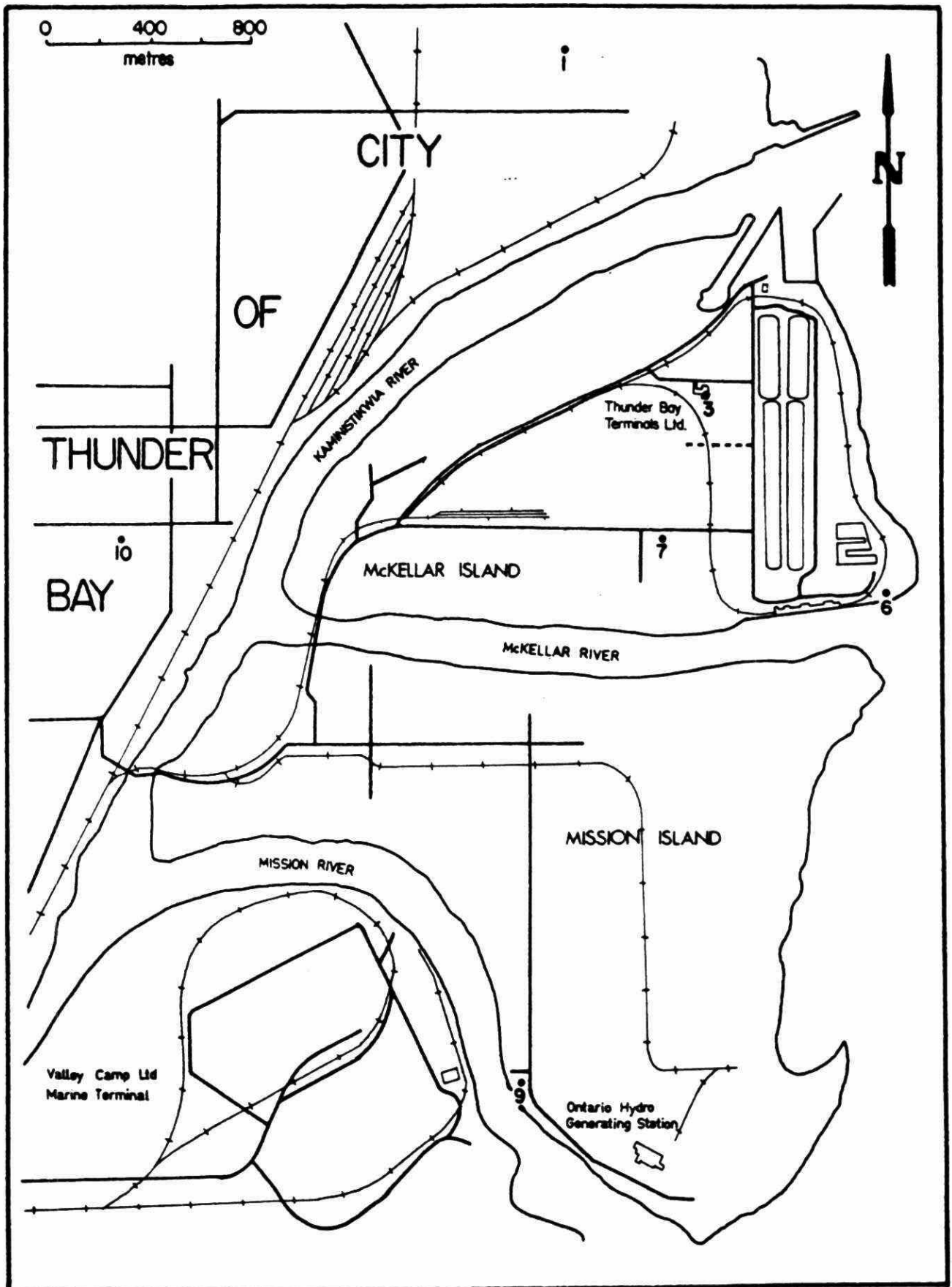


Figure 1. Air quality monitoring sites, Thunder Bay Terminals Limited.

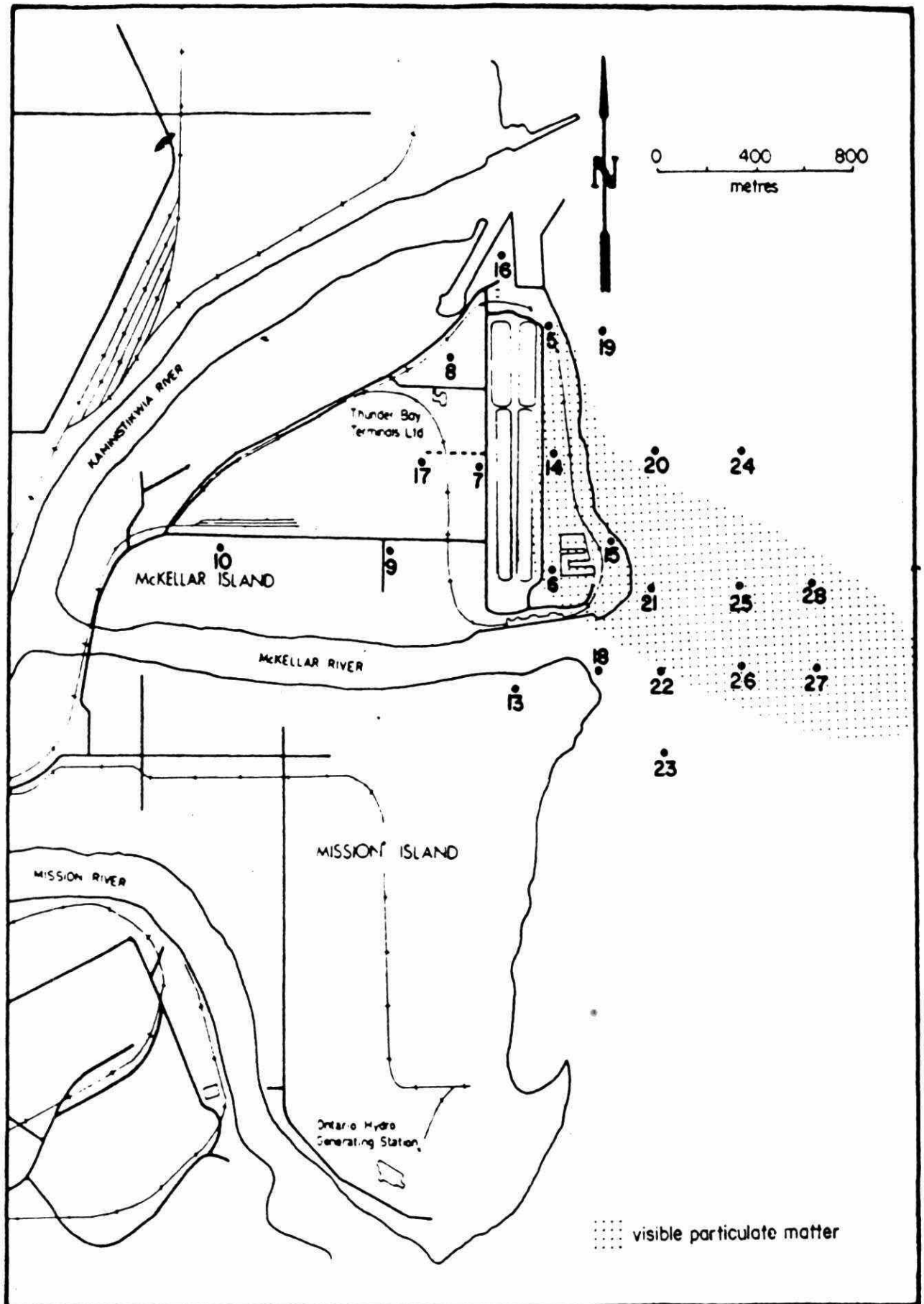


Figure 2. Snow sampling sites, Thunder Bay Terminals Ltd., February 13, 1990.

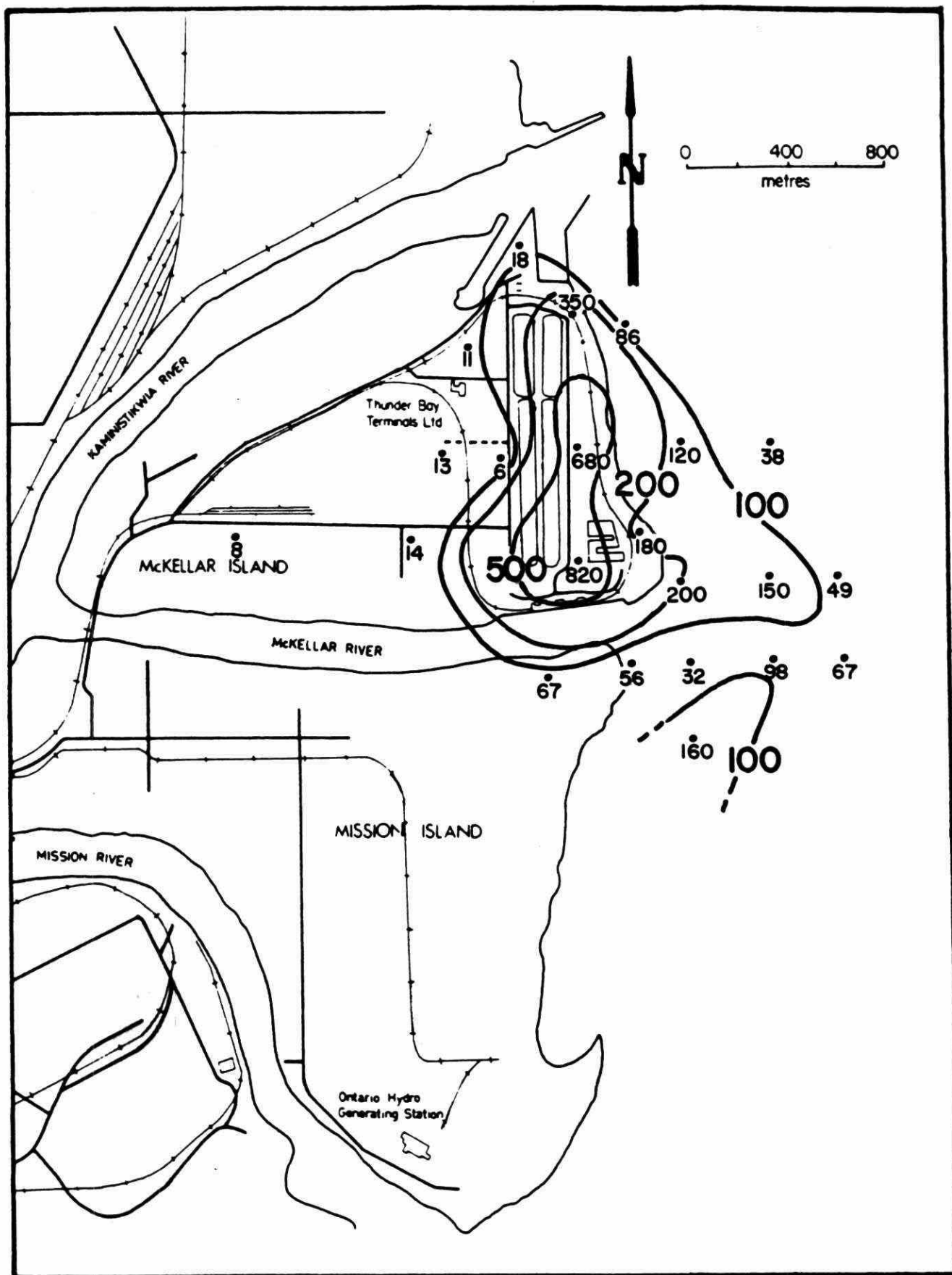


Figure 3. Particulate carbon (mg/l) in snow near Thunder Bay Terminals Limited, February 13, 1990.

TABLE 1. Total dustfall ($\text{g/m}^2/30$ days) near Thunder Bay Terminals Limited, 1989.

Site	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1	Sewage Treatment Plant	2.5	3.5	1.2	2.5	6.0	3.1	1.5	2.4	2.5	1.9	2.4	3.7	2.8
3 ^a	Thunder Bay Terminals	4.3	6.2	1.7	3.5	<u>7.4</u>	<u>8.5</u>	3.4	3.9	3.1	3.8	2.1	3.3	4.3
6 ^a	Thunder Bay Terminals	5.7	4.6	3.0	5.0	6.1	4.2	-	2.8	<u>7.3</u>	4.8	6.9	3.0	<u>4.9</u>
7 ^a	Thunder Bay Terminals	1.6	2.2	1.3	1.0	6.3	1.7	1.6	4.2	3.0	2.8	1.6	4.0	2.6
9	Kam Boating Club	0.6	0.5	1.0	1.6	3.2	1.9	2.1	2.0	1.4	1.2	0.7	0.5	1.4
10	McKellar Hospital	1.0	1.6	2.3	3.6	4.4	2.6	<0.5	2.3	2.2	1.1	2.1	1.0	2.0

^aSites on company property.

^bValues exceeding maximum acceptable levels of 7.0 (monthly) or 4.6 (annual mean) are underlined.

- Invalid data.

TABLE 2. Average annual dustfall ($\text{g}/\text{m}^2/30 \text{ d}$) near Thunder Bay Terminals Limited, 1976-1989.

Monitoring site	Location	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	Sewage Treatment Plant	3.2	4.4	3.2	2.8	2.5	2.1	2.8	3.4	3.6	<u>6.1</u> ^a	1.8	2.7	3.5	2.8
3 ^a	Thunder Bay Terminals	4.2	4.2	2.7	2.7	<u>5.2</u>	3.6	<u>4.7</u>	<u>8.2</u>	<u>5.0</u>	<u>8.1</u>	3.6	3.9	4.3	4.3
6 ^a	Thunder Bay Terminals					<u>8.5</u>	<u>6.9</u>	<u>8.8</u>	<u>19.5</u>	<u>15.3</u>	<u>15.7</u>	3.5	<u>5.1</u>	<u>4.7</u>	<u>4.9</u>
7 ^a	Thunder Bay Terminals					<u>7.9</u>	4.3	3.2	<u>16.1</u>	4.0	<u>7.2</u>	2.3	3.2	3.3	2.6
9	Kam Boating Club	<u>5.6</u>	4.6	4.3	4.2	2.5	2.1	3.4	1.7	2.1	1.9	1.7	1.4	2.3	1.4
10	McKellar Hospital	3.5	<u>5.0</u>	3.8	3.8	4.0	3.7	3.8	3.1	3.4	3.9	2.8	2.9	3.5	2.0
Averages						5.1	3.8	4.4	8.7	5.6	7.2	2.6	3.2	3.6	3.0

^aSites on company property.

^bValues above maximum acceptable level of 4.6 are underlined.

TABLE 3. Concentrations of total suspended particulate matter ($\mu\text{g}/\text{m}^3$) near Thunder Bay Terminals Limited, 1989.

Monitoring Sites ^a				Monitoring Sites ^a			
Date	1	3 ^b	10	Date	1	3 ^b	10
Jan 4	39	39	41	Jul 3	20	32	40
10	31	30	24	9	12	23	50
16	10	13	32	15	11	20	45
22	28	39	49	21	18	31	119
28	36	35	20	27	39	52	-
Feb 3	20	27	36	Aug 2	59	81	63
9	20	25	52	8	54	59	108
15	36	46	31	14	22	25	20
21	18	24	43	20	51	56	15
27	18	28	27	26	31	53	38
Mar 5	27	50	31	Sep 1	31	70	20
11	8	23	45	7	41	65	59
17	37	49	41	13	29	38	26
23	31	64	-	19	47	50	47
29	27	39	18	25	17	25	19
Apr 4	29	53	17	Oct 1	39	53	20
10	27	36	33	7	35	46	59
16	24	38	52	13	18	57	26
22	23	37	67	19	40	58	47
28	54	76	67	25	67	101	19
May 4	14	37	70	31	32	89	9
10	10	38	63	Nov 6	38	45	15
16	39	52	94	12	33	75	18
22	33	53	66	18	30	66	18
28	35	51	49	24	54	65	53
Jun 3	12	22	31	30	39	63	19
9	32	46	43	Dec 6	26	32	-
15	52	59	64	12	38	40	20
21	62	94	72	18	32	35	20
27	39	51	33	24	37	40	30
				30	63	34	31
				Annual Means:	29	43	36

^a See Figure 1.

^b Site on company property.

^c Values above the 24-hour objective ($120 \mu\text{g}/\text{m}^3$) are underlined.

TABLE 4. Annual geometric means ($\mu\text{g}/\text{m}^3$) of total suspended particulate matter near Thunder Bay Terminals Limited, 1976-1989.

Year	Sewage Treatment Plant (Site 1 ^a)	Thunder Bay Terminals (Site 3 ^a)	McKellar Hospital (Site 10 ^a)
1976	41	47	49
1977	31	33	36
1978	27	34	44
1979	30	33	51
1980	28	33	44
1981	31	39	52
1982	28	32	39
1983	27	42	36
1984	38	59	44
1985	28	37	36
1986	34	49	40
1987	30	46	36
1988	34	50	37
1989	29	43	

^aSee Figure 1 for site locations.

TABLE 5. Concentrations of selected parameters in snow meltwater from samples collected February 13, 1990, near Thunder Bay Terminals Limited, Thunder Bay.

Sampling site ^a	Aluminum ($\mu\text{g/l}$)	Particulate carbon (mg/l)	Chloride ($\mu\text{g/l}$)	Iron ($\mu\text{g/l}$)	Potassium ($\mu\text{g/l}$)	Total solids (mg/l)
5 ^b	2300 ^c	350	3800	6300	3800	690
6 ^b	<u>4200</u>	<u>820</u>	1200	<u>10000</u>	<u>960</u>	<u>2600</u>
7 ^b	<u>3400</u>	<u>6</u>	1000	<u>4200</u>	480	<u>250</u>
8 ^b	<u>390</u>	<u>11</u>	7200	<u>860</u>	390	<u>60</u>
9	420	<u>14</u>	<u>900</u>	<u>660</u>	300	<u>60</u>
10	380	<u>8</u>	1300	840	380	<u>50</u>
13	680	<u>67</u>	1000	1100	520	<u>140</u>
14 ^b	<u>2200</u>	<u>680</u>	1300	<u>5700</u>	930	<u>1400</u>
15 ^b	<u>1100</u>	<u>181</u>	900	<u>2200</u>	480	<u>410</u>
16 ^b	<u>370</u>	<u>18</u>	1000	<u>720</u>	450	<u>65</u>
17	480	<u>13</u>	1000	<u>1100</u>	370	<u>110</u>
18	390	<u>56</u>	800	<u>630</u>	440	<u>140</u>
19	650	<u>86</u>	1600	1400	670	<u>170</u>
20	<u>790</u>	<u>120</u>	1300	<u>1700</u>	540	<u>250</u>
21	<u>820</u>	<u>200</u>	1000	<u>1600</u>	410	<u>490</u>
22	<u>560</u>	<u>32</u>	1200	<u>720</u>	370	<u>100</u>
23	<u>1000</u>	<u>162</u>	800	<u>1300</u>	350	<u>340</u>
24	<u>340</u>	<u>38</u>	400	<u>530</u>	230	<u>85</u>
25	580	<u>150</u>	1100	1000	450	<u>250</u>
26	<u>700</u>	<u>98</u>	1000	<u>1200</u>	650	<u>210</u>
27	<u>660</u>	<u>67</u>	900	<u>950</u>	330	<u>130</u>
28	<u>500</u>	<u>49</u>	500	<u>690</u>	250	<u>100</u>
Controls	180	3	150	200	140	11
Guidelines	500	7	4000	700	1000	40

^a See Figure 2.

^b Sites on Thunder Bay Terminals property.

^c Values above contaminant guidelines are underlined.

TABLE 6. Comparison between concentrations (mg/l) of selected parameters in meltwater from snow sampling surveys conducted in 1975, 76, 79, 80 and 90 near Thunder Bay Terminals Limited, Thunder Bay

	Aluminum					Carbon					Iron					Suspended Solids				
	75 ^a	76 ^b	79 ^c	80 ^c	90 ^d	75	76	79	80	90	75	76	79	80	90	75	76	79	80	90
5 ^e			44.5 ^f	10.5	2.3			1100	100	360			35.5	15.5	6.3			2500	430	480
6 ^e	0.4	0.1	37.5	48.5	4.2	2	2	930	1300	820	0.2	0.4	26.0	39.0	10.0	35		1700	4200	2100
7 ^e				16.5	3.4				520	7				10.6	4.2				1200	210
8 ^e	0.6	0.3	2.6	2.8	0.4	3	3	15	100	12	1.2	1.2	9.8	2.2	0.9	60		100	200	40
9			3.4	1.0	0.4			150	24	15			2.8	1.9	0.7			200	110	40
10			<0.5	0.6	0.4			7	8	9			1.2	2.0	0.8			15	42	35
13			<0.5	<1	0.7			15	16	69			1.3	3.0	1.1			32	85	120
14 ^e				20.0	2.2				1300	680				17.0	5.7				2200	1100
15 ^e				10.0	1.1				160	180				9.6	2.2				670	310
16 ^e				1.4	0.4				62	19				1.9	0.7				70	55
17				2.1	0.5				35	14				5.0	1.1				110	45
Controls	0.2	0.1	<0.5	<1	0.2	1	<1	3	4	4	0.1	0.2	0.4	<1	0.2	30		7	18	10
Guidelines			0.5					10					0.7					25		

^aAverage of values from two surveys (January, March). Fixed depth sampling (20 cm). Single samples.

^bFixed depth sampling (20 cm). Single samples.

^cComplete profile sampled. Duplicate samples for each site.

^dComplete profile sampled. Single samples.

^eSite on Thunder Bay Terminals property.

^fValues above guidelines are underlined.

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